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ABSTRACT

There seem to be few answers to questions asked concerning how a curriculum might be structured, or how a curriculum is currently formulated, and what the implications might be of structuring a curriculum in various ways. Most of the literature in this area consists of either arguments for "psychological" versus "logical" structure or inconsistent research findings. An attempt is made in this paper to provide a useful set of concepts for theory and research. A set of three major categories for classifying types of curriculum structure is developed, tested, and presented: (1) goal-derived; (2) means-derived; and (3) subject matter-derived. Each category is explicated by indicating paradigms and examples of that structure category. (Author/WM)

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# An Analysis of Curriculum Structure

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Curriculum theorists have repeatedly stressed the importance of providing for structure in the curriculum (Rugg, 1927; Tyler, 1950; Bruner, 1961; Taba, 1962; Goodlad and Richter, 1966; Johnson, 1967; Gagné, 1970). But the curriculum field lacks the concepts necessary to do adequate research in this area. This paper attempts to analyze the concept of curriculum structure. It builds on the principal investigator's previous analysis of curriculum structure extensiveness (Posner, in press) by analyzing the kinds of structure possible in curriculum. The paper presents a typology of curriculum structuring criteria, describes the typology's implications for curriculum development and evaluation and concludes with a set of potentially fruitful research directions. To begin the discussion, a definition of curriculum needs to be stipulated, since any concept of curriculum structure presupposes a concept of curriculum.

## CURRICULUM

Curriculum, for the purpose of this paper, is defined as "a structured series of intended learning outcomes" (Johnson, 1967). A curriculum, according to this conception, consists of a series of intended learning outcomes (ILO's) organized into some structural arrangement. The basic unit of a curriculum is, thus, an ILO or a micro-curriculum element. In contrast to micro-elements, macro-elements are classes or categories of ILO's.

Curriculum can be conceptualized at different levels of generality depending upon whether structure involves micro- or macro-elements. Micro-elements, (individual intended learnings, i.e., cognitions, performance capabilities, or affects) are revealed by analysis of classroom discourse, textbooks, and lists of behavioral

objectives or major ideas. Macro-elements (groups of micro-elements) can occur at different levels of generality, ranging from a lesson, to a unit, to a course, to a whole program and are revealed by analysis of such documents as syllabi, curriculum guides, course offerings, and program sequences.

Having specified what is meant by curriculum and by curriculum elements, the discussion turns to the concept of curriculum structure.

## THE CONCEPT OF CURRICULUM STRUCTURE

Structure refers to the relationships between elements. In the present paper these elements are ILO's or categories of ILO's. Therefore, an analysis of curriculum structure should consider two aspects, namely, the extent of relationships and the kinds of relationship between curriculum elements. The former is termed "extent of curriculum structure" and the latter (which is the focus of this paper) is termed "types of structuring criteria".

## EXTENT OF CURRICULUM STRUCTURE

In a previous work (Posner, in press) the concept of curriculum structure was explored with regard to curriculum structure extentsiveness. After a review of the literature, the work of four writers (Tyler, 1950; Schrader, 1972; Anderson, 1971; Driggs, 1968) was synthesized into a two-dimensional schema. This schema includes the commonality and the temporality of the relationships between curriculum elements.

Commonality. The first factor, commonality, refers to the degree to which pairs of elements are identical versus independent (Anderson, 1971). A continuum can be imagined along the dimension of commonality. Pairs of elements with the greatest degree of commonality are those in which each of the elements in a pair are identical or repeated. At the other end of the continuum are pairs of elements in which each of the elements in a pair is completely unrelated to the other element. Between these two extremes are those pairs in which elements are neither identical nor independent but are related in some way.

Temporality. The second dimension of curriculum structure in this schema is the temporal quality of the relationship between elements. Elements in this schema can be either a) vertically related (i.e., one element temporally subsequent to another) or b) horizontally related (i.e., two elements temporally concurrent). In addition, vertically related elements can be either contiguous (i.e., one element related to another element directly following the first) or non-contiguous (i.e., one element related to another, temporally separated from the first by one or more unrelated elements). Since the distinction between contiguous and non-contiguous elements implies that elements are temporally separated, it does not apply to horizontally structured elements.

Since this schema has been previously explicated, the authors will not elaborate on these two dimensions here. Suffice it to say that the concepts of "commonality," "temporality," "contiguity," and "micro- and macro-level elements" are useful. They are useful

for framing research questions regarding the extent of curriculum structure and its effects on educationally significant variables. They also enable one to translate the many inconsistently defined terms in the curriculum structure literature (such as "spiraling," "continuity," "sequence," "integration," "coherence," "progression," "hierarchical structure," "flat structure," and "vertical structure") into a more consistent and parsimonious set of concepts.

## TYPES OF STRUCTURING CRITERIA

Although the previously discussed schema appears to provide adequate concepts for thinking about the extent of curriculum structure, the schema proposed is not appropriate for addressing the equally important question of structuring criteria or principles.

For example, curriculum elements structured (either vertically or horizontally) according to a familiar-to-remote criterion or principle are clearly "related". The same is true for elements structured according to a concrete-to-abstract criterion or principle. But one cannot claim that the former criterion represents more or less "commonality" than the latter criterion. This example suggests the limitations of the concepts thus far identified. What is still lacking is a system describing types or kinds of relationships possible between "related" curriculum elements. That is, a typology of structuring criteria would provide a set of concepts useful for framing research questions concerning optimal kinds (rather than the optimal extent) of relationships between curriculum elements. Each type of criterion should differ with respect to what constitutes a "good" curriculum sequence.

Debates about criteria for structuring or sequencing are an historically common phenomenon and have typically centered around a subject matter-versus-learner dichotomy. That is, the recurrent question in debates has been as follows: Should the curriculum and its organization be based on the subject matter or on the learner?

This question, although important, needs to be refined into sub-questions before one can use it to generate a typology of structuring criteria. As a guide in this initial task, it is useful to depict the education process identifying relationships between the learner and the subject matter. The reader will note in Figure 1 that the concept of "subject matter" includes three distinct aspects, namely, phenomena in the world (e.g., people, objects, and events), knowledge (i.e., concepts) about the phenomena, and the process by which such knowledge is produced (i.e., "inquiry").[1] Note also that the model includes both the consequence of the subject matter-learner interaction, namely, the learning outcomes, and the utilization of the learning outcomes in pursuit of life goals.

[Figure 1 about here]

The model depicted in Figure 1 leads to a five-category classification of structuring criteria summarized by the following questions:

1. World-related. What are the empirically verifiable relationships between the phenomena (people, things or events) in the world about which the pupil is to learn and how can the curriculum be sequenced so that the organization is consistent with the way the world is?

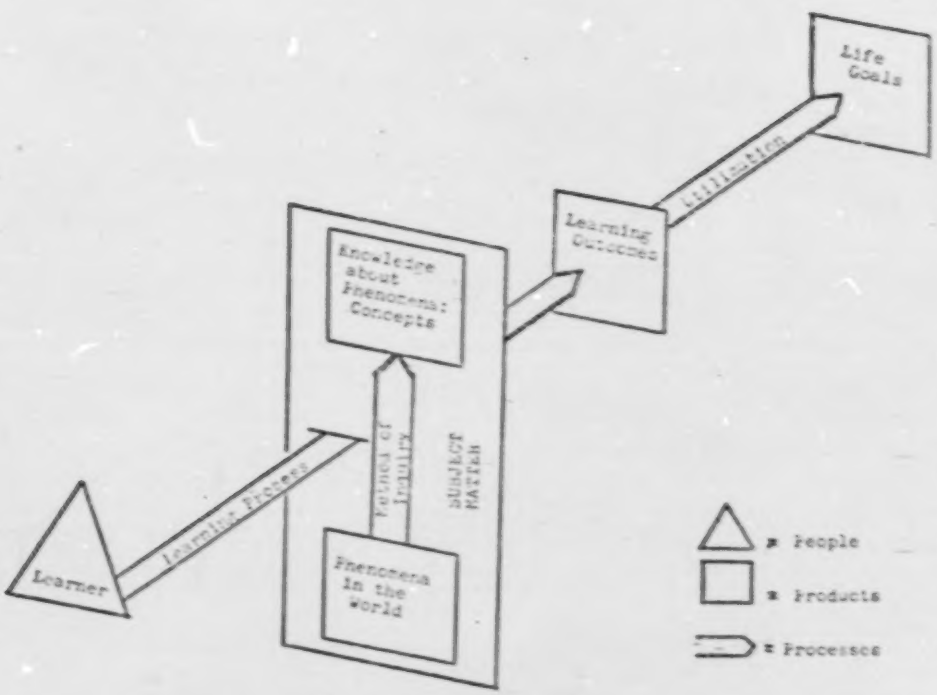


Figure 1. The Interaction of the Learner and Subject Matter: Sources of Criteria.

2. Concept-related. What are the conceptual properties of the knowledge which the pupil is to learn and how can the curriculum be sequenced so that it is logically consistent in organization to the organization of the concepts?

3. Inquiry-related. How are knowledge claims produced and how can the curriculum be sequenced so that it is consistent with this process of inquiry?

4. Learning theory-related. How does the pupil learn and how can the curriculum content be sequenced to provide for optimal learning efficiency, retention, and transfer?

5. Utilization-related. How will the pupil utilize the curriculum content after he has learned it and how can the content be sequenced so that it is consistent with the utilization process?

In summary, individual intended learning outcomes (ILO's) and categories of ILO's can be sequenced according to five different bases: a) a world-related basis (i.e., based on empirically discoverable relations between people, things or events), b) a concept-related basis (i.e., based on relations among concepts), c) an inquiry-related basis (i.e., based on the process by which knowledge is produced), d) a learning theory-related basis (i.e., based on the psychology of learning), and e) a utilization-related basis (i.e., based on the way things are used after they are learned).[2] The world-, concept- and inquiry-related bases for sequence are concerned with the subject matter and the way that subject matter comes to be. On the other hand, the learning theory- and utilization-related bases are reliant on human purposes and psychologies and are more concerned with economy of learning for the individual learner.

## Types of Curriculum Sequencing Principles

The five major types of sequencing principles are presented below. In addition, several of the more interesting and important[3]

sub-types[4] are described for each major type. It should be noted that the examples used to illustrate each sub-type were selected on the basis of their relative "purity," not on the basis of their representativeness. That is, typical instances of actual curriculum sequences are combinations of several of the sub-types and even several of the major types. This is not only expected but probably desirable. The types and sub-types, although conceptually distinct, are rarely found in curricula in their "pure" form. For example, it is unlikely to find any whole curriculum that is a pure "world-related" type much less a pure example of a world-related sub-type, such as "space." However, it is not unreasonable to expect to find particular sequences that emphasize a particular type or even sub-type. Nevertheless, this paper makes no claim as to the desirability of such "purity" in actual curricula. Such questions of optimal kinds of sequence are answered by research, the subject of a later section.

1.0 World-related. World-related sequences embody as a criterion consistency between curriculum structure, on the one hand, and relationships between phenomena as they exist or occur in the world on the other hand. That is, the curriculum structure should reflect empirical relationships between events, people, and things. World-related sub-types include spatial relations, temporal relations, physical attributes, function, abundance, value, part-whole, etc. An examplar of this type is the typical structure of history courses based on the chronological sequence of events (i.e., the sub-type termed "time" or "temporal relations").

1.1 Space. Sequences based on spatial relations are those in which the curriculum elements are ordered in accord with the physical arrangement or position of the phenomena of interest. (Anderson, 1969, pp. 18-19) Sequencing principles of this sub-type include closest-to-farthest, bottom-to-top, east-to-west, etc. Examples: Learn the appropriate duties of the offensive line, the half-backs, and the quarterback in that order. Learn the parts of a plant from the root, to the stem, to the leaves and flower, in that order. Learn the names of the states according to geographical location.

1.2 Time. A temporal relationship between curriculum elements reflects an antecedent-consequent order between events, or outcomes of those events. That is, often the curriculum (most typically a history curriculum) is sequenced chronologically from the earliest to the most recent events (Anderson, 1969, pp. 20-21). Sequences embodying a temporal dimension include cause-and-effect and ideological influence. Examples: Learn the major ideas of Marx before learning about the nature of the Russian revolution (Ideological Influence). Learn about George Washington's term of office before John Adams' term of office (Historical Chronology). Learn the names of the states in order of admission to the Union (Historical Chronology). Learn about the forces that cause mountain building before learning the types of mountains (Cause and Effect).

1.3 Physical Attributes. World-related curriculum sequences may be based on physical characteristics (chemical properties are included) of the phenomena of interest such as size, age, shape, number of sides (e.g., in geometry), brightness (e.g., in astronomy), hardness (e.g., in geology), complexity (e.g., in comparative anatomy), and countless other characteristics. This sub-type is most commonly found in the natural sciences since these disciplines are concerned with properties of things in the natural world. Examples: Learn the hardness scale for minerals from softest to hardest (Hardness). Learn the names of the states in size order (Size). Learn the names of the 3 largest Indian tribes before learning the names of the 3 smallest (Size). Learn the names and capitals of Alaska, Texas, California, etc. (from largest to smallest) in that order (Size). Learn the relative proportions of Helium and Hydrogen in stars from those of greatest absolute brightness (Supernovae) to those of least absolute brightness (Black Dwarfs) (Brightness). Learn the anatomy of an amphibian, then a shark, then a cat (Complexity). Learn the structure of a primitive society before studying a complex industrial society such as ours (Complexity).

1.4 Function. Learning the characteristic actions of a phenomenon in conjunction with learning about the phenomenon is a typical basis for structuring curricula. Functional relations are of two sorts which may be termed the teleological and the non-teleological aspects of function. When the char-

acteristic actions of a phenomenon are purposefully directed, we may consider the functions to be teleological, e.g., the functions of the various occupations. Many natural (rather than man-made) phenomena have functions that are typically considered to have no overall design or purpose, e.g., the effects of river flooding on a valley. These latter functions are regarded here as non-teleological. It should be obvious that often non-teleological functions are more appropriately considered dysfunctions. Examples: Learn the functions of the respiratory system before learning its characteristics. Learn what a monetary system is, then learn that monetary systems are useful in trading (Teleological). Learn how a river contributes to erosion, how it serves as a mode of transportation and how it results in flood disasters (Non-Teleological) (Includes Dysfunctions).

2.0 Concept-related. While world-related criteria presumably reflect the organization of the empirical world, concept-related criteria reflect the organization of the conceptual world. That is, according to criteria of this type, the curriculum is supposed to be structured in a manner that is consistent with the way concepts relate to one another. Often referred to as the "logical structure," this type focuses on the properties of knowledge in its "final" form when relationships between premises and conclusions can be analyzed. Four concept-related sub-types are described below: class relations, propositional relations, sophistication level, and logical pre-requisite. A traditional curriculum embody-

ing concept-related criteria in its structure is geometry when taught deductively (i.e., the sub-type termed "propositional relations"). More recently developed curriculum approaches placing a high priority on the organization of concepts include most of those curricula developed during the 1960's "curriculum reform movement" (e.g., BSCS biology, ESCP earth science, PSSC physics, CHEM Study chemistry, etc.). These curricula were described by the slogan "the structure of the disciplines."

2.1 Class Relations. A class concept is a concept which selects or groups a set of things or events as instances of the same kind of thing in that they share common properties. Common class relations are inclusion, membership, union, and intersection. The concepts superordinate and subordinate sometimes denote class relations. Sequencing principles of this sort include teaching about the general class prior to teaching about its members, or investigating the properties of instances of a class before investigating the properties of the class. Examples: Compare the chemical properties of carbon with that of silicon. Compare the size of angles in regular pentagons, hexagons, and octagons. Compare the anatomy of bees, ants, and termites. Learn what an internal combustion engine is before learning about rotary and piston engines.

2.2 Propositional Relations. A proposition is a combination of concepts which asserts something. Common relations between propositions include entailment, contradiction, premise-conclusion, and theory-fact. Sequencing principles of this sort

include teaching evidence prior to the proposition which the evidence supports or teaching a theory prior to the facts which the theory explains. Examples: Acquire a general understanding of the theory of natural selection before studying the adaption of Darwin's finches (Theory - Instance). Learn the principle of "equal protection under law" before learning the 1954 Supreme Court decision on Civil Rights. Learn in deductive order the steps in a geometric proof. Learn the volume of a gas at several temperatures and pressures before learning Boyles Law (Evidence - Conclusion).

2.21[5] Reduction Level. A set of laws or a scientific theory is reduced to another set of laws or scientific theory when the laws at one level (the micro-level) may be used to explain the laws at a different level (the macro-level) and when the macro-level laws can be derived from the micro-level laws. For example, many of the laws of chemical bonding (macro-level) can be explained by and derived from laws concerning the behavior of elementary particles (micro-level). A common sequencing principle is to teach the micro-laws prior to teaching the macro-laws. Examples: Learn about chemical compounds before learning about biological organisms. Learn about atomic structure before learning about chemical compounds.

2.3 Sophistication. Concepts and propositions can differ in their level of precision ("acceleration" is less precise than "v/t"), complexity (the number of concepts subsumed by a con-

cept), abstractness (the distance from particular things or facts, usually the opposite of "concrete"), vagueness (the extent to which a concept bears a "family resemblance" to other concepts, usually the opposite of "clarity"), range (the number of instances to which a concept refers) and level of refinement (adding qualifications to a concept or proposition refines it). Sophistication embodies all of these aspects and the above list is intended to be representative rather than exhaustive. The concept of sophistication is similar to that of Bruner (1961) in his discussion of the "spiral" curriculum which returns periodically to concepts at higher and higher levels of sophistication. Examples: Learn the real numbers before learning about imaginary numbers (Abstractness). Learn how events can be ordered chronologically before learning the concept of time (Abstractness). Learn what "acceleration" means before learning it as "v/t" (Precision). Learn the concept of "stimulus" before the concept of "conditioning" (Complexity) (also 2.4). First learn the concept of "democracy" then learn the concept of "representative democracy" (Level of refinement).

2.31 Abstractness. Abstractness concerns the distance of concepts or propositions from particular things or facts. Thus, one concept is more abstract than another if one contains the other, and one proposition is more abstract than another if it is a central part of a theory or set of propositions from which the less abstract proposition can be derived. Comparisons concerning abstract-

ness can be made between unrelated conceptual hierarchies when these hierarchies are sufficiently well formulated to permit identification of distinct levels of abstractness. A common sequencing principle is to teach the less abstract prior to the more abstract.

2.4 Logical Pre-requisite. A concept or proposition is a logical pre-requisite to another concept or proposition when it is logically necessary to understand the first concept or proposition in order to understand the second. Examples: Learn what "velocity" means before learning that "acceleration" is the change in velocity.

3.0 Inquiry-related. Inquiry-related sequencing principles are those which derive from the nature of the process of generating, discovering or verifying knowledge. Therefore, such principles reflect the nature of the logic or methodology of a given area of thought. Dewey's attempt to structure teaching according to his analysis of the scientific method is a major example of an inquiry-related sequencing principle. There are two sub-types which we shall call the logic of inquiry and the empirics of inquiry.

3.1 Logic of Inquiry.[6] Logic may be narrowly defined as the science of valid argument or more broadly as the analysis of the norms of adequate inquiry. Sequencing principles rooted in logic will reflect views of valid inference. For example, two different logics yield differing sequencing principles concerning discovery learning. A view which considers discovery to be a matter of generalizing over numerous instances

(i.e., induction) will provide instances of a generalization prior to attempting to have the student discover the generalizations. A view which considers discovery to be a matter of testing bold conjectures will seek to elicit hypotheses and then turn to a process of evidence collection. Examples: Learn that Galileo hypothesized that the change in velocity per unit of time for a freely falling object is a constant; then learn that any object we allow to fall freely accelerates at 9.8 m/sec., so long as air resistance is not a factor (hypothesis - Evidence Collection).

3.2 Empirics of Inquiry. Some features of proper inquiry are rooted in descriptions of how successful scientists actually proceed or in the social or psychological conditions of fruitful inquiry. Let us suppose for example that successful inquirers were found to study a problem area before working on specific problems. This might lead to a sequencing principle emphasizing the need for a general survey of an area prior to consideration of special problems. Examples: Learn what other researchers have discovered about reinforcement schedules before learning to frame hypotheses about optimal reinforcement schedules.

4.0 Learning theory-related. Learning theory-related curriculum sequences draw primarily on knowledge about the psychology of learning[7] and the technology of teaching (see, for example, Skinner, 1968; Gagné, 1970; Schutz and Baker, 1971) as a basis for curriculum development. The major criteria for this type of curriculum sequencing principles are learning effectiveness, retention, and transfer of

learning. Most psychologists, although they might disagree about the particular instructional approach to be used, argue that the subject matter is not as relevant to curriculum structuring criteria as is knowledge about the way people learn. Five learning theory-related sub-types have been identified: Empirical pre-requisite relationship, degree of familiarity, degree of difficulty, degree of interest, and degree of internalization. An exemplar curriculum sequence of this type is AAAS' Science - A Process Approach which employs the sub-type termed "pre-requisite relationships" and ESS science which emphasizes the sub-type termed "interest."

4.1 Empirical Pre-requisite. If the learning of one curriculum element facilitates or even makes possible the learning of a subsequent element, the first element can be termed a pre-requisite of the second. Gagné serves as the leading advocate of this sequencing criterion through his work in curriculum development (see AAAS' Science - A Process Approach), curriculum research (Gagné, 1967), learning theory (Gagné, 1970) and curriculum theory (Gagné and Briggs, 1974). Examples: Learn to discriminate between initial consonants; then learn to use work attack skills; then learn to read. Learn to discriminate cats from dogs before learning the concept of "cat." Learn where each of the typewriter keys are before learning how to type.

4.2 Familiarity. An individual's past experiences are often the basis of sequencing, as was discussed under 4.1 above. Familiarity refers to the frequency with which an individual has encountered an idea, object or event, i.e., how common it

is to the individual. Phenomena he has never seen or phenomena he has heard about only occasionally are considered remote from the individual's experiential past. The sequencing principle employed is to order elements from the most familiar to the most remote. Examples: Learn about American schools before learning about Swedish schools. Learn the various occupations in the local community before learning about careers in other communities and in other nations.

4.3 Difficulty. Some things are more difficult to learn than others. Those aspects of difficulty that depend on factors already mentioned, such as pre-requisite learnings, abstractness, familiarity, etc., are excluded from the present sub-type since they are included in others. Factors affecting difficulty as conceived here include a) how fine a discrimination is required and b) how fast a procedure must be carried out and c) the mental capacity required for learning (e.g., memorizing five names is typically more difficult than memorizing two names). Sequences employing this criterion would teach the least difficult curriculum items before the more difficult ones. Examples: Learn long vowel sounds before learning short ones. Learn to weave slowly, then learn to speed up. Learn to spell short words before longer words.

4.4 Interest. Curriculum elements that are intrinsically interesting are typically those that refer to phenomena about which the learner has had some limited experience (i.e., not totally unknown to him) but remain a challenge, retain the

potential for surprise, or can arouse curiosity. Although interest is often more attributable to instructional method than to the nature of the curriculum element, there appear to be some elements which have more potential for learner interest. The most common sequencing principle here is to begin a sequence with those elements which are more likely to evoke pupil interest. Examples: Learn how to pick a lock before learning the way a lock works.

4.5 Internalization. When the educational intent of a sequence is to have the pupil internalize an attitude or value, one can order elements (here, affective TLO's) in a manner that reflects an increasing degree of internalization. Stages or levels of internalization have been suggested by Krathwohl et al (1964) as follows: a) Receiving, b) Responding, c) Valuing, d) Organization, e) Characterization by a Value or Value Complex. Examples: Learn to listen willingly to Marxian ideas, then learn to voluntarily interpret events in terms of a Marxian ideology, then learn to view the world based on a Marxian value system.

5.0 Utilization-related. A fifth category of curriculum structuring criteria focuses on the way the learning outcomes are to be used. For certain kinds of content areas (e.g., occupational and vocational education) that which is to be learned is typically sequenced in an order reflecting the procedural order in which the skills are to be used or the order of importance in utilization. This major type can be conceived of as a combination of the "life activities" and the "job-analysis" modes of organization (see, for example, Saylor and Alexander, 1966, pp. 173-182 for a comparison of these two modes).

5.1 Procedure. In training programs when we are teaching a procedure or process and the curriculum elements represent steps in the process, it is often appropriate for the curriculum sequence to reflect the order in which the steps will be followed when carrying out the procedure.

One important type of procedure that is often taught is the procedure used in confronting personal or societal problems (e.g., career decision making or air pollution). When curriculum elements are selected for the purpose of enabling the pupil to solve these types of life-related problems, the elements may be sequenced in an order consistent with the individual's utilization of knowledge for this purpose. For example, pupils might learn the effects of air and water pollution (i.e., establish a phenomenon as a "problem"), then learn the causes (i.e., analyze the problem), and then learn how to eliminate or correct the factors that cause pollution (i.e., suggest solutions). Examples: Learn, in order, the steps followed when starting a car. Learn the effects, the cause and possible solutions to pollution in that order.

5.2 Anticipated Frequency of Utilization. Often we teach the most important curriculum elements first and by "most important" we mean those which the pupil is likely to encounter most often. That is, we predict the likelihood of encounters the pupil will have with various phenomena and we order the phenomena about which he is to learn based on the anticipated frequency of utilization in his future experiences.[8] Examples: Learn to use chi-square and correlation coefficients before factor analysis, the Mann-Whitney U Test, and the Fisher Extract Probability.

## TESTING THE TYPOLOGY

This typology, because it presumes to be comprehensive (for the major types of the typology if not for its sub-types), needs to be tested. However, since a typology is a set of concepts, it cannot be considered true or false but, instead, useful or not useful in thinking about relevant issues. This testing can be divided into two aspects: a "conceptual test" and a "reality test". Since the authors are currently carrying out these tests, the discussion below represents a set of first thoughts on the matter and are presented only to give a glimpse into some kinds of approaches that can be used.

### CONCEPTUAL TEST

One way to conceptually test both the schema for describing extent of structure and the five-category typology of structuring criteria is to attempt to translate commonly used terms in the literature into the terminology of these two conceptual systems.

In terms of curriculum structure extensiveness, for example, "continuity" (Tyler, 1950; Schrader, 1972) and "commonality" (Anderson, 1971) both refer to the repeating of vertically contiguous elements. "Sequence" (Tyler, 1950), "Spiraling" (Schrader, 1972), and "vertical structure" (Briggs, 1967) are all terms for the relating of vertically contiguous elements. "Spiraling" (Bruner, 1961) can be considered the relating of vertically non-contiguous elements. "Integration" (Tyler, 1950) is equivalent to the relating of horizontal elements. "Flat structure" (Briggs, 1967) and "progression"

(Anderson, 1971) both refer to unrelated elements, the former in the horizontal direction and the latter in the vertical direction.

Likewise, the typology of structuring criteria can be used as a common set of concepts for thinking about the kinds of criterion considered by various writers to be of prime importance. Let us examine some of the more interesting past and current concepts of structuring criteria in the light of the typology.

Ausubel (1964) contends that the introduction of a learning sequence with a generalized overview (i.e., an "advance organizer") that links up with the pupils existent "cognitive structure" provides the pupil with the necessary "subsumers" for the subsequent learning to become "meaningful". In terms of the present typology, these "advance organizers" appear to be a juxtaposition of the "class relations" sub-type, 2.1 (since the organizer subsumes the subsequent learning), and the "familiarity" sub-type, 4.2 (since the organizer must "fit" the pupil's cognitive structure, a product of his past experiences). Therefore, Ausubel's "advance organizers" may be considered an interesting marriage of concept-related and learning theory-related criteria. He appears to have adopted a criterion of one type and tempered it with a criterion of another type. Perhaps his integrative approach explains his ability to engage in productive dialogue with other more monolithic theorists like Schwab and Gagne who represent divergent criterial bases.

In contrast to Ausubel, Schwab (1964) relies heavily on the "substantive" and "syntactical" structure of the disciplines for both selection and sequencing criteria. In fact, he considers the

use of any single theory of learning as a guide to curriculum development to be wrongheaded (Schwab, 1970). In terms of the present typology, Schwab seems to be emphasizing the concept-related (i.e., the "substantive" structure) and the inquiry-related (i.e., the "syntactical" structure) types.

Other writers tend less to cut across major and even sub-types in the typology. For example, Gagné (1970) and Briggs (1968) in their discussions of "hierarchies of competence" are concerned solely with "empirical pre-requisites."

Other current concepts of curriculum structure need to be analyzed in the light of the frameworks discussed in this paper in order to test the frameworks further.

REALITY TEST

Not only should the typology be tested by attempting to relate the concepts to other theorists' concepts, but also by assessing its applicability to actual curricula. This kind of testing could be organized around the following phases:

1) Identification of types of offerings (programs or courses) within a particular setting (e.g., community colleges, secondary schools, etc.)
2) Selection of a paradigm example of each type. This procedure insures the representativeness of the set of programs or courses to be examined.
3) Collection of documents (e.g., course or program outlines, texts, etc.) of each paradigm example.
4) Analysis of each document in an attempt to fit the typology to the curricula reflected by the documents. That is, the materials are examined in order to determine the usefulness

of the tentative typology categories in classifying the kinds of sequencing principles and to ascertain if the typology contains any significant omissions.

5) Interview with teaching staff members whenever the documents collected and analyzed are found to provide insufficient information.

6) Audio-taping actual classes for each paradigm example. The tapes can then be analyzed in an effort to determine the nature of the sequencing principles being employed by the teacher. This phase is necessary, since curriculum documents often do not provide an accurate description of the teachers' curriculum (i.e., the teachers' intentions).

## IMPLICATIONS

The typology of structuring criteria, like the conceptual schema of structure extensiveness presented previously, is a set of concepts. As such, its ultimate value also is in providing tools of thought. These concepts can presumably help guide the thought of the curriculum developer, evaluator, and researcher.

### CURRICULUM DEVELOPMENT

The curriculum developer, according to the definition of curriculum stipulated previously, has two major tasks; he must select and he must structure curriculum elements.[9] In the selection process he can be guided by various frameworks available in the literature, such as the "taxonomies of educational objectives" (Bloom et al, 1956; Krathwohl et al, 1964; Harrow, 1972), "realms of meaning" (Phenix, 1964), and "domains of learning" (Gagné and Briggs, 1974), to mention just a few. If he does not want to state the objectives him-

self, he may even buy objectives from one of the available "banks" (IOX, for example).

When it comes to structuring the ILO's, however, he has no comprehensive framework that can serve as a reference. One use of the typology presented here is to fill this void. It can serve as a "shopping list" of sequencing principles for any curriculum developer, whether he be an individual teacher or a state syllabus writer. Use of the typology increases the probability that he will use a particular sequencing principle because the chosen principle is the most appropriate for his purposes, not because he has never thought of any alternative principles. That is, the use of the typology will presumably lead to greater flexibility by developers of curriculum sequences.

CURRICULUM EVALUATION

The curriculum evaluator often needs to examine the curriculum itself in addition to the measured outcomes of the program. Previously this type of "intrinsic" evaluation (Scriven, 1967) has been limited to classifying the ILO's, comparing the ILO's with the philosophy and with the instructional plan designed for their implementation. The frameworks presented here make it possible to describe both the extensiveness of structure and the kinds of structuring principles employed. This data may have some utility, especially when comparing competing curricula. However, for this data to have much meaning in decision making, these variables must be shown to relate to other significant educational variables (e.g., learning outcomes). That is, the use of descriptive data on curriculum structure for decision making presupposes research regarding

the effect of curriculum structure on the educational process or its products.

CURRICULUM RESEARCH

What has been termed the "hidden curriculum" has received much attention lately. Typically this phrase refers to the bureaucratic organization of the school and what this administrative arrangement teaches pupils (see, for example, Dreeben, 1962; Apple, 1971). However, the "hidden curriculum" may also refer to that which is contained in the curriculum but not stated as an ILO. According to the definition of curriculum stipulated earlier, a curriculum is more than a set of ILO's; it is a structured set of ILO's. Therefore, when a particular ILO is learned, it is learned in conjunction with others, so that relationships between ILO's are learned in addition to the ILO's themselves. This fact is overlooked by educational psychologists and others who think of curriculum structure as a determinant only of how well elements are learned. They ignore the fact that curriculum structure also determines, in part, what is learned.

A research question concerned with this kind of "hidden curriculum" is as follows: In pursuing common educational goals (e.g., driving a car), what are the differential effects (in terms of a wide range of outcomes) of divergent curriculum structures? Although different structures may result in equally effective (in terms of achieving the educational goal) curricula, each structure may result in different conceptions of the subject matter, different conceptions of the way to continue learning, and other important but often overlooked outcomes.

Another set of research questions suggested by the typology is as follows: What kinds of sequencing criterion do different kinds of curricula (e.g., academic versus occupational) employ? Are some types of criterion (e.g., learning theory-related) appropriate and typical for all curriculum areas? Are some types of criterion (e.g., inquiry- and concept-related) appropriate and frequent only for certain curriculum areas (e.g., the disciplines of mathematics and science)? Are some types of criterion (e.g., utilization-related) typically found only in certain kinds of curricula (e.g., occupational education) but are appropriate and perhaps desirable for all curriculum areas?

## Notes

[1]The authors recognize that there is much knowledge that is produced, not by inquiry but by trial and error and other processes. Inquiry is most closely associated with disciplined knowledge, whereas other processes of knowledge production (e.g., trial and error) are most closely associated with non-disciplinary knowledge. However, rarely, if ever, are these latter processes used as sources for structuring criteria. They are, therefore, omitted from Figure 1.

[2]The authors realize that many decisions regarding curriculum sequence are not based on any of these five types of criteria but, instead, on factors relating to implementation of the curriculum in a specific situation. Such factors as materials and facilities available, time schedules, weather and climate, location of the school, transportation needs, and teachers' interests or competence are likely to be powerful determinants of curriculum sequencing. These factors have been referred to as "frame factors" (Dahllof, 1970). Such factors may be considered a sixth major type, termed "implementation-related".

[3]The typology is presumed to be comprehensive for the major types but not for the sub-types.

[4]The authors' "sub-types" correspond to Anderson's "organizational principles" (1969, p. 23) and are referred to in the present paper as "structuring principles," "sequencing principles," "structuring criteria," and "sequencing criteria." A series of curriculum elements employing one or more sequencing principles in combination is termed an "organization," a "structure," or a "sequence."

[5]The numbering indicates that this concept is an instance of 2.2 but is of sufficient interest to merit special treatment.

[6]This sub-type obviously has a relation to the sub-type concerned with relations among proposition under the major category, concept-related. An inquiry-related structure which depends on the logical features of inquiry does so because of the logical relations between propositions. This suggests that there may be a number of cases where a given structural relation between two or more curricular elements will be an instance of more than one type or sub-type.

[7]The present typology does not include a human development category (e.g., Piagetian stages). This omission is based on the distinction between structuring and grade or age placement. Some theorists, most notably Smith, Stanley and Shores (1957), equate the two considerations. However, the present authors agree with Johnson that "curriculum ordering disregards temporal spacing (grade or age placement)" (1967, p. 138).

[8]Note the difference between this sub-type and 3.3 above, Familiarity. In Familiarity we base our sequence on an estimate of the number of past encounters the pupil has had with the phenomenon. In contrast with Familiarity, Anticipated Frequency of Utilization, 5.2, bases sequence not on past encounters but on predictions of future encounters. Note also the difference between 5.2 and Abundance (a world-related sub-type). Abundance refers to the frequency of occurance of a phenomenon in the world today whereas 5.2 refers to the probability that a person will encounter a phenomenon in the future.

[9]The authors recognize that the selection and structuring of curriculum elements are not typically independent procedures. For example, a decision that an "advance organizer" (Ausubel, 1964) is to be learned first (i.e., a structuring decision) necessarily entails a decision that an "advance organizer" is to be learned (i.e., a selection decision). However, the focus of this paper has been on the structuring task.

As a matter of fact, the five major types of structuring criteria also turn out to be types of selection criterion. Although the five types appear to be comprehensive with regard to structuring criteria, they omit some important types of curriculum selection criterion. Criteria based on the social context of education, termed societal determinants of the curriculum (Tyler, 1950; Taba, 1962), and criteria based on the psychology of human development are two types of criterion that appear to be relevant to the task of selecting appropriate curriculum elements but not to the task of structuring the elements. The latter is implicit in Figure 1 (the component termed "learner"), whereas the former would require placing the entire diagram within a "societal" frame. Thus, with some modifications Figure 1 could be made to represent both selection and structuring criterial types.

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